

**Link plate, chain link and energy guide chain, as well as intermediate piece for an energy guide chain, with torsion-coupled locking means to link the transverse link and the link plate**

The invention refers to a link plate of an energy guide chain, a chain link of an energy guide chain, an energy guide chain, and an intermediate piece for an energy guide chain.

Energy guide chains are frequently used when a moveable component, especially a component which moves essentially on a predetermined track, is to be supplied, for example, with current, water, consumables or similar. In this case, the lines from a fixed point must be led to the component so that the movement of the component on its predetermined track is made possible without any damage to the lines.

The energy guide chain consists of chain links which are linked together in an articulated manner, where the energy guide chain is moved along a predetermined track. Here the lines in the energy guide chain are guided practically in a predetermined manner so that the lines are exposed to only a very slight wear, if any.

A chain link has two link plates which form the side boundaries of the chain link and at least transverse link which forms the upper and/or lower limit of the chain link. The chain links are designed so that a chain link can be joined to at least one neighboring chain link and/or to at least one end piece in order to thus form the energy guide chain. Mostly this linking is done through corresponding joining means, which are formed correspondingly in the neighboring link plates.

The link plate and transverse link can be made of one piece, for example, from a plastic, especially produced by injection molding, but it is also customary to form the transverse links and the link plates so that they can be joined together separably. A separable joint of the link plate with at least one transverse link has the advantage that access to the lines becomes easy so that inserting or taking out lines from the chain as well as possible access to the lines for maintenance purposes is easily possible.

Several possibilities are known in the state of the art for forming a separable joint between transverse link and link plate. For example, from WO 00/63586 A1 a lock-in connection is known to be used between transverse link and link plate which can be

separated without the use of tools, manually. In the case of such a joint, unintended separation of the joint may occur easily.

An energy guide chain is known from WO 98/34040 A1 in which the transverse link has end sections for joining the transverse link to the link plate, which makes pivoting of the transverse link around pivoting axes in the two end sections possible.

An energy guide chain is known from US 4,807,432 in which always one transverse link per chain link is joined separably to the link plates. Here the joining to the two link plates is done with the aid of lock-in catches, each of which is always formed on the transverse links. The disadvantage here is that the widths of the chain links, that is, the length of the transverse links, must be known even already during the manufacture of the transverse links, since the locking catches have to be produced when forming the transverse links.

Based on the above, the task of the invention is to provide a link plate, a chain link, an energy guide chain and a fixing means for an energy guide chain which makes it possible to produce a separable joint between the transverse link and link plate in a simple manner which, in spite of this, is so solid that unintended opening of the joint is excluded.

This task is solved by a link plate with the characteristics of Claim 1, a chain link with the characteristics of Claim 13, an energy guide chain with the characteristics of Claim 21 and an intermediate piece with the characteristics of Claim 22.

For a simplified manner for producing a joint between a transverse link and a link plate for a chain link of an energy guide chain, it is proposed that the link plate have a fixing means which is suitable and intended for separable joining of the link plate to a transverse link. The fixing means has at least one locking means. Furthermore, at least one torsional element is provided. This is joined to the fixing means and a wall of the link plate so that it can be pivoted out essentially around a longitudinal axis of the link plate. At least for the release of a transverse link, the at least one torsional element is twisted essentially around a longitudinal axis of the link plate. Through this design of a link plate according to the invention, a safe and reliable joint between the link plate and the transverse link is made possible.

In a preferred embodiment of the link plate, the fixing element does not protrude beyond the edge of the link plate, so that unintended separation of a transverse link joined to the link plate is avoided. The safety can be increased further by making the top side of the transverse link essentially flush with the fixing element or having it lie above the fixing element. In such a design of the link plate, the fixing means preferably has an area for insertion of a tool, into which a tool, for example a screwdriver, can be inserted. Using the tool, through the fixing means a torsional moment is introduced into the torsional element. If the torsional moment is high enough, the fixing element will be pivoted so that the transverse link is released. Resetting of the fixing means into its rest position occurs automatically through the torsional element when the transverse link would be disassembled.

The useful cross-section of an energy guide chain is also determined by the distance of the link plates to one another. In order to design the useful cross-section of an energy guide chain as effectively as possible, according to an advantageous embodiment of the link plate it is proposed that the fixing means be arranged in a receptacle which extends at least from an inner wall in the direction of an outer wall of the link plate and that the fixing means be dimensioned so that the fixing means is integrated essentially completely in the receptacle. This is not absolutely necessary. It is also possible that at least one locking means is designed protruding from the inner wall. This is not critical when the locking means protrudes into the transverse link.

The receptacle in the wall of the link plate can be designed in the form of an opening. In the case of this design, the fixing means and the link plate are made from several pieces. The fixing means is preferably joined to the link plate non-separably. It has the corresponding fixing means which make it possible to attach the fixing means to the link plate in the receptacle. Here, for example, it can be barbed gaps, which cooperate with the correspondingly formed means on the fixing means. Specifically, it is proposed that torsional elements be provided on both sides of the fixing means which are designed correspondingly so that these torsional elements penetrate partially into the gap formed in the wall of the link plate. Having the link plate made of several pieces has the advantage that optionally different fixing means can be used depending on the purpose of application. Thus, for example, a type of a fixing means can be used for different link plates when these link plates have essentially identically formed receptacles. The joining of the fixing means to the receptacle can be done by positive and/or non-positive locking.

In order to avoid increased assembly expenditure, which occurs in handling link plates made of several pieces, according to a further advantageous embodiment of the link plate according to the invention, it is proposed that the fixing means and the link plate be made of one piece. Such a one-piece design is especially advantageous when the link plate is made from a plastic.

The wall and/or the at least one fixing means are preferably made of at least one plastic, at least one elastomeric plastic, a renewable raw material and/or metal. Thus, for example, it is possible to produce the wall and the fixing means from one or several plastics, while the at least one torsional element is made of a metal. Such a design is advantageous, especially when, in the case of relatively thin walls of the link plate, there is a danger that the torsional element might break.

Through WO 98/34050, a link plate is known which can be joined to a transverse link so that the transverse link is pivotable around a longitudinal axis of the link plate. This has the advantage that in the case of a chain link the transverse link can be separated from the link plate while maintaining the joint with the other link plate. As a result of this, it is ensured that the transverse link will not be lost. In order to avoid loss of a transverse link, according to a further advantageous embodiment of the link plate according to the invention, it is proposed that at least one pivoting axis receptacle be formed to hold a pivoting axis of a transverse link and/or of an intermediate piece. The pivoting axis receptacle and the fixing means represent functional units which are independent of one another, so that in the case of the link plate according to the invention, it is possible to join the link plate to transverse links, which are either pivotable or non-pivotable.

Transverse locking means are provided in order to prevent that the transverse link undergo a relative movement in the direction essentially transverse to the longitudinal axis of the link plate, in the case of joining the link plate with a transverse link. With this measure, it is achieved, in the case of an energy guide chain which is built from chain links which have at least one link plate according to the invention, that during the operation of the energy guide chain this transverse link will not become separated from the link plate according to the invention.

In order to further increase the safety, it is proposed that the link plate according to the invention have longitudinal locking means, which, when joining the link plate to a

transverse link, essentially prevent a relative movement of the transverse link in a direction essentially parallel to the longitudinal axis of the link plate.

Above it was shown that the torsional element is subjected to a torsional moment in order to make it possible to separate a transverse link from the link plate according to the invention. In order to prevent the applied torsional moment from exceeding a maximum permissible torsional moment, it is proposed that means be provided for limiting the excursion of the fixing means.

According to another inventive thought, a chain link for an energy guide chain is proposed with two link plates which are joined together at least through one transverse link, and that at least one link plate be designed according to one of Claims 1 to 11.

According to an advantageous embodiment of the chain link, it is proposed that a transverse link cooperate with at least one fixing means. Here it is advantageous when at least one locking means cooperates with a locking receptacle of the transverse link. Preferably here the chain link is designed so that the locking means and locking receptacle can be joined together by positive and/or non-positive locking. The locking receptacle is preferably formed in a front face of the transverse link. The locking receptacle can also have a profile which corresponds to that of the transverse link. Then the transverse link can be designed as a profile section. Here it is preferable to have the transverse link made of metal or plastic. The transverse link can be from an extruded semi-finished product with corresponding profile design.

In order to prevent the occurrence of unintended separation of a transverse link from the link plate or upon action of forces during the operation of an energy guide chain with a chain link according to the invention, it is proposed that a minimum force be necessary for separating the transverse link and the fixing means, especially of the locking means and the locking receptacle. This minimum force can assume different values depending on the design of the chain link and on the purpose of application of the chain link. Here it is preferable to design the chain link so that the minimum force is not too high, and manual opening of the transverse link by an operator is still possible.

According to yet another advantageous embodiment of the chain link according to the invention, it is proposed that longitudinal and/or transverse locking receptacles be

formed on the transverse link which can be engaged with the longitudinal and/or transverse locking means with positive or non-positive locking.

In order to realize a pivotable joint of a transverse link to a link plate, it is proposed that at least one pivoting means be formed on a joining side between the transverse link and the link plate, on the transverse link, and that this can be engaged in the pivoting axis receptacle.

Alternatively or additionally, the chain link can also be designed in such a way that at least one intermediate piece is provided which takes up on one side the joining side of the transverse link and the other side of which has at least one pivoting means which can be engaged in the pivoting axis receptacle of the link plate.

The chain link can also be the end link for an energy guide chain. Such an end link has two link plates but here they each can have only one linking region. In addition, the chain link may have a device with the aid of which the end link can be joined to a fixing means at the fixed location of the movable connection.

According to still another inventive idea, an energy guide chain with at least one chain link according to one of Claims 13 to 20 is proposed. Such an energy guide chain is characterized by the fact that it can be manufactured easily and simply. Moreover, unintended separation of the transverse links from the link plates can be avoided safely and reliably.

According to yet another inventive idea, a fixing means is proposed which is suitable and which is intended for separable linking of the link plates to a transverse link, where the fixing means has at least one locking element joined to at least one torsional element. The at least one torsional element can be joined to a wall of the link plate so that the fixing means can be pivoted essentially around a longitudinal axis of the link plate.

A design of the fixing means in which the torsional element is designed as at least one torque rod is preferred. The term rod includes different cross-sectional shapes of the torsional element. The torsional element can have a rectangular cross-section. Essentially circular cross-sections of the torsional element are also possible. The torsional element can be an integral component of the fixing means. The fixing means

can also be made of several parts, where the locking element forms one part and the at least one torsional element another part and the locking means is joined to the torsional element preferably so they cannot be separated.

According to a preferred embodiment of the fixing means, it is proposed that the locking means be arranged between two torsional elements.

Other details and advantages of the invention will be explained with the aid of the practical examples shown in the drawing, without the object of the invention being limited to these specific practical examples. The following are shown.

Figure 1 is a link plate in a front view,

Figure 2 is a sectional representation along line A-A of Figure 1,

Figure 3 is a perspective view from the front of an area of a link plate with a fixing means,

Figure 4 is the section of Figure 3 in a perspective view from the back,

Figure 5 is a section of a link plate joined to a transverse link,

Figure 6 is a perspective view of an intermediate piece from above,

Figure 7 shows the intermediate piece according to Figure 6 in a perspective view from underneath,

Figure 8 is a section of a link plate with a transverse link joined with an intermediate piece,

Figure 9 is a perspective view of the transverse link according to Figure 8 in the pivoted position.

Figure 1 shows a practical example of a link plate 1 for a chain link of an energy guide chain. The link plate 1 has opposite-lying formed link regions 2, 3. The link regions 2, 3 are preferably formed so that they are complementary to one another, so that

link plates can be joined to one another in an articulated manner. There are numerous possibilities for the design of link regions 2, 3 to which the person skilled in the art can refer.

Link plate 1 has a fixing means 4 for the purpose of separable joining of the link plate to a transverse link. The design of the fixing means can be seen specifically in Figures 3 and 4.

The fixing means 4 has a locking means 5. Furthermore, fixing means 4 has two torsional elements 6, which are joined to the link plate. In the practical example shown, the torsional elements 6 have an essentially rectangular cross-section. They are joined on the one hand to fixing means 4 and on the other hand to an edge region of a receptacle 7. The receptacle 7 which holds the fixing means 4 extends from an inner wall 8 in the direction of an outer wall 9 of the link plate. Receptacle 4 [sic, should be 7] furthermore extends from an edge 10 in the direction of the opposite edge of the plate.

In the practical example shown, the fixing means 4 is made in one piece with the link plate 1. The fixing means is joined to the edge region of receptacle 4 through torsional elements 6. Figure 4 shows that the fixing means 4 is separated from the link plate through an essentially U-shaped free space 11. A tool access region 12 is provided in the upper part of fixing means 4. The tool access region has an essentially rectangular cross-section in the practical example shown here so that, for example, a screwdriver can be introduced into the tool access region. By pivoting the tool which is now shown here, the fixing means 4 is pivoted essentially around a longitudinal axis of link plate 1. The pivoting motion of the fixing means is shown in Figure 3 by arrow A when a transverse link, which is not shown, is to be separated.

The locking means 5 has a feed slope 13 which extends in the direction of inner wall 8. A free space is provided below locking means 5 into which an end region of a transverse link engages. During the formation of a joint between link plate 1 and a transverse link, for example, a force is applied onto the transverse link transversely to the longitudinal direction of the plate. The edge of the transverse link slides on the feed slope 13, as a result of which fixing means 4 will be pivoted. The locking means 5 pivots back when this engages in a cavity formed on a front face of the transverse link. Figure 5 shows a joint of a link plate 1 with a transverse link 14. The transverse link 14 is designed as a longitudinal profile piece. It has a cavity 15 which extends in the



longitudinal direction of the transverse link. This is not absolutely necessary. It is sufficient when the cavity 15 is dimensioned so that the locking element 5 can engage in it.

In order to limit the pivotal motion of the fixing means, especially when the transverse link is dismounted from the link plate, a stop 16 (Figure 1) is provided underneath the fixing means.

In the practical example shown, the torsional elements 6 have an essentially rectangular cross-section. This is not absolutely necessary. It is possible for the torsional elements to have other as well as different cross-sections and shapes. It is also possible to join the fixing element to the link plate through several torsional elements 6.

The transverse link 15 shown in Figure 5 has openings 17 in its end regions. In the mounted state, pegs 18 engage through openings 17. The pegs 18 are arranged on protrusions 19. The protrusions 19 are essentially perpendicular to inner wall 8. Protrusions 19 are profiled. They engage in the corresponding regions 20 of transverse link 14. An embodiment is preferred in which regions 20 form a joint with protrusions 19 in a positive or non-positive locking manner.

Pegs 18 and protrusions 19 form transverse or longitudinal locking means with the correspondingly formed transverse links. Through the transverse locking means, when joining the link plate to a transverse link, essentially a relative motion of the transverse link in the direction essentially transversely to the longitudinal axis of the link plate is prevented. The longitudinal locking means are designed so that when joining the link plate to a transverse link, essentially a relative motion of the transverse link in a direction essentially parallel to the longitudinal axis of the link plate is prevented.

Furthermore, the link plate has a pivoting axis receptacle 21 which is suitable and is intended for accepting a pivoting axis of a transverse link and/or of an intermediate piece 22. The design of an intermediate piece is shown in Figures 6 and 7. The intermediate piece 22 has two pivot shafts 23. The pivot shafts 23 are placed at a distance from one another. They are suitable to be introduced into the corresponding pivot shaft receptacles of the pivotal axis receptacle 21 whereby the joint between the link plate and the intermediate piece is designed so that the intermediate piece 22 cannot be separated from the link or can only be separated upon application of an increased force.

The distance between the pivot shafts 23 is to be dimensioned so that the possibility of movement of the fixing means 4 is not hindered. The pivot shafts 23 are joined to connecting elements 24. The connecting element 24 has a protrusion 25 which engages into a correspondingly designed receptacle 28 in transverse link 14. In addition, each connecting element 24 has a wrap-around 26 which encompasses the longitudinal edge region 27 of transverse link 14. The connecting elements 24 are joined together through a fixed link 29.

Figures 8 and 9 show the intermediate piece 22 joined to a transverse link 14, which is joined to a link plate.

The protrusions 25 of intermediate piece 22 engage in the recesses 28 of transverse link 14. The wrap-arounds 26 encompass the longitudinal edge regions 27 of transverse link plate 14. The pivot shafts 23 are arranged in the corresponding recesses of pivoting axis receptacle 21. Furthermore, it can be seen from the representation in Figure 8 that the pegs 18 extend through openings 17. The pegs 18 are designed so that when the transverse link 14 is pivoted, they do not hinder this pivoting process. Figure 9 shows the transverse link in a pivoted position.

## Reference list

- 1 Link plate
- 2 Link region
- 3 Link region
- 4 Fixing means
- 5 Locking means
- 6 Torsional element
- 7 Receptacle
- 8 Inner wall
- 9 Outer wall
- 10 Edge
- 11 Free space
- 12 Tool access region
- 13 Feed slope
- 14 Transverse link
- 15 Cavity
- 16 Stop
- 17 Opening
- 18 Peg
- 19 Protrusion
- 20 Region
- 21 Pivoting axis receptacle
- 22 Intermediate piece
- 23 Pivot shaft
- 24 Connecting element
- 25 Protrusion
- 26 Wrap-around
- 27 Longitudinal edge region
- 28 Recess
- 29 Fixed link